

## Acoustic Activity of Bats in Kentucky during the Total Solar Eclipse of 2017

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**Abstract** - We characterized patterns of bat activity outside primary hibernacula of *Myotis* bats at Mammoth Cave National Park on the days preceding, concurrent with, and following the total solar eclipse which occurred on 21 August 2017. Additionally, we documented nightly patterns of bat activity for hydric habitats and forest corridors across Kentucky during a 7-d period encompassing the eclipse. Our results suggest there was no diurnal bat activity occurring in response to the total solar eclipse, and there was no clear evidence of altered nightly activity patterns. However, these observations provide baseline data for future study of bat responses to eclipse events.

Bat-emergence patterns are inherently cyclical, but are subject to light disturbance. Experimental manipulation of external lighting has been shown to result in delayed emergence and reduced activity of numerous bat species (Stone et al. 2015). Considering the novelty of such observations, our objective was to assess patterns of bat activity in the context of the atypical light conditions imposed by a total solar eclipse occurring on 21 August 2017. Although total solar eclipses are rare, this event was conspicuous and widespread in its impact as it traversed a wide swath of North America (NASA 2017a). Our acoustic surveys during this eclipse incorporated data from 3 sites in Kentucky, located ~20, 115, and 110 km, respectively, from the path of total occultation: Mammoth Cave National Park in Edmonson County, Lower Howard's Creek Nature and Heritage Preserve in Clark County, and Floracliff Nature Sanctuary in Fayette County. These sites experienced 99.5%, 94.7%, and 94.9% solar occultation, respectively (NASA 2017b). During the hour of the eclipse, ambient light at Mammoth Cave National Park decreased by ~80% (NPS 2017). In contrast, ambient light decreased by ~30% in Madison County, adjacent to both Clark and Fayette Counties (M. Ciocca, Eastern Kentucky University, Richmond, KY, unpubl. data). We hypothesized that abnormal activity patterns would be more likely to occur at Mammoth Cave National Park given its proximity to the path of total eclipse.

We conducted acoustic sampling of caves at Mammoth Cave National Park from 20 to 22 August 2017; the sampling interval represented 1 day prior to, the day of, and 1 day following the eclipse. We deployed Song Meter SM3BAT Ultrasonic Recorders (Wildlife Acoustics, Maynard, MA) that were active 24 h a day at a default sampling rate of 256 kHz at the principal, gated entrances of Dixon Cave and Long Cave. These caves are Priority 1 hibernacula for *Myotis sodalis* Miller and Allen (Indiana Bat) (USFWS 2007) and, despite the impact of White-nose Syndrome, continue to support thousands of bats throughout the winter months (R. Toomey, Mammoth Cave National Park, KY, pers. comm.).

Additionally, we deployed 5 Song Meter SM2BAT<sup>+</sup> Ultrasonic Monitors (Wildlife Acoustics) on the landscape of Mammoth Cave National Park (37°11'13.2"N, 86°06'05.2"W), Floracliff Nature Sanctuary (37°54'10.1"N, 84°21'35.3"W), and Lower Howard's Creek Nature and Heritage Preserve (37°55'09.4"N, 84°16'25.4"W) from 18 to 24 August. The SM2BAT<sup>+</sup> units were active from sunset to sunrise and recorded at a sampling rate of 384 kHz; we chose detector locations to represent both forest corridors and hydric

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habitats where we expected greater bat activity (Fulton et al. 2014). We employed Kaleidoscope Pro analysis software (Version 3.1.4B) to quantify echolocation passes. Sensitivity settings selected passes containing a minimum of 2 pulses ranging from 8 kHz to 120 kHz in frequency and 2 ms to 500 ms in duration.

Nocturnal data from forested habitats displayed no clear trend in hourly bat activity across nights (Table 1). Only 3 echolocation passes were recorded at cave entrances between sunrise and sunset during our sample period, and none occurred during the eclipse. However, we recorded an average of 529.7 and 2497.7 echolocation passes per 24-h day at Dixon Cave and Long Cave, respectively, confirming bat presence on the landscape. While historical reports of bat behavior during eclipse events are scarce, Wheeler et al. (1935) observed several bats in flight during a total solar eclipse. In contrast, Krzanowski (1959) observed no emergence during totality. Our observations suggest that bats in Kentucky did not become active during the daylight hours of the eclipse. While our results do not fully reconcile previous reports, these observations do provide a benchmark of acoustic activity that may inform future studies of bat responses to infrequent meteorological events.

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Table 1. Total number of echolocation passes recorded at Dennison Ferry (Edmonson County, KY), Floracliff Nature Sanctuary (Fayette County, KY), and Lower Howard's Creek Nature and Heritage Preserve (Clark County, KY) from 18 to 24 August 2017. Detectors were operational from sunset to sunrise. A total solar eclipse occurred in the afternoon hours of 21 August 2017.

Site	Total Passes						
	18 Aug	19 Aug	20 Aug	21 Aug	22 Aug	23 Aug	24 Aug
Mammoth Cave (Dennison Ferry)	3	0	1	0	0	145	71
Floracliff (Pond)	3	0	0	0	3	3	1
Floracliff (Road)	46	43	32	48	2	24	66
Lower Howard's Creek (Creek)	26	6	9	5	3	12	11
Lower Howard's Creek (Corridor)	8	8	2	5	3	1	8

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